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SCIENCE & TECHNOLOGY

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CONTENTS

REPORT ON DEVELOPMENT OF INDUSTRIAL BIOTECHNOLOGIES

Sofia KHIMIYA I INDUSTRIYA in Bulgarian No 5, 1984 pp 228-231

/Article by Engineer Nikolay Komarov, candidate of economic sciences: "Development of Biotechnologies in the Chemical Industry of the Bulgarian People's Republic"/

/Text/ The successes of contemporary biology, combined with achievements in a number of other scientific branches, has led to the formation of a new strategic direction in scientific and technical prograsm--biotechnologies. Biotechnologies, by constantly pervading chemistry and medicine, metallurgy and machine building, power engineering and electronics, are becoming one of the most important factors in progressive production redesign, renovation, and intensification, and in a number of countries they have already been promoted to the rank of state policy.

Our party and government have valued in a timely manner the prospects and strategic importance of biotechnologies, and they have created the necessary conditions for scientific research and implementation activity. Resolution No 96/27.6.1983 of the Council of Ministers for intensive development and application of biotechnologies in the national economy is an expression of this evaluation. "Our present task is to proceed to large-scale development and application of biotechnology in our country, on the basis of the successes achieved during recent years in separate biological directions and on the economic and scientific-technical potential of the country, by using the enormous possibilities of socialist integration...." The resolution emphasizes: "The intensive development of research and production related to biotechnology, and its broad application in the national economy, should be considered a scientific-technical, socioeconomic, and political task of strategic importance."

Biotechnological methods open up new, nontraditional capacities, which have not been used thus far, for implementing advanced technologies in the various branches of industry, medicine, and agriculture. Biotechnological methods, with their wide range of applications in the area of microbiological synthesis, genetic engineering, and preservation and reconstruction of the ecological balance of nature, offer extremely great possibilities for the successful and effective solution to a number of important problems in our socioeconomic development.

The achievements in biotechnology in our country are indisputable. The results obtained in the chemical and pharmacological industries in the production of antibiotics for human and veterinary medicine, amino acids, biopreparations for plant protection, and others, are particularly signifciant. Enzyme production is being developed at a high rate. Scientific research activity in the area of biosynthesis of proteins, the production and implementation of microalgae, and others is being intensified. The first results in the area of biomachine building are already here.

The achievements in the production of human antibiotics have been especially lofty.

The production of antibiotics in Bulgaria began in 1954 with the construction of the Antibiotics Plant in Razgrad (then called the Penicillin Plant), which is now specialized and is the only enterprise in the country for the production of drugs and medical preparations for human medicine. The plant, which was built entirely according to Soviet design and with Soviet technical assistance, has been expanded several times. During 1983, using the development and applications base at the plant, a scientific research institute for antibiotics was created, and the plant itself grew into the Combine for Scientific Research on Antibiotics. Today, the Scientific Production Combine for Antibiotics in Razgrad produces antibiotics in the form of drugs and over-the-counter medical preparations for satisfying domestic needs and export requirements to socialist and nonsocialist countries (over 70 percent of the production is exported to over 50 countries).

During the 30-year period since the establishment of the combine, its power capacities have increased 20 times, through new construction, reconstruction and modernization, adoptions of new antibiotics, and expanding the nomenclature of medicinal drugs. Improvement and perfection of existing technologies is the main contribution to the large scale of production. The combine now produces a broad range of antibiotics, semisynthetic antibiotics--ampicillin, carbenicillin, carbiphene, amoxicillin, and over 150 perpared medicinal drugs for human and veterinary medicine. By the end of 1983 and the beginning of 1984, the Scientific Production Combine for Antibiotics in Razgrad began the production of a new antibiotic, azlocillin, and a broad range of cephalosporin antibiotics, cephalexin, cephalothin, cephaloridine, cephoram, and others. The production of apicyclin, tobramycin, lyncomycin, erythromycin, and others will be implemented in the near future. In 1984, the plant will undergo a new expansion: intensification of tetracycline production, a cephalothin workshop, and others, will begin to operate on a regular basis.

During 1983, two operating fermentator-microprocessor systems for control of fermentation processes were tested and implemented at the Scientific Production Combine for Antibiotics in Razgrad. This is a great technical accomplishment because for the first time in Europe, microprocessor technology has been used at fermentation plants for the production of antibiotics.

The main trends in the combine's future development, according to the plan developed, are as follows:

--Intensification of the main production: tetracycline, tubocin, gentamycin, tylosin, penicillin G, oleandomycin, through improvement of existing technologies and increasing the capacity of cubic meters of installed fermenting capacity.

--Implementing the production of new antibiotics, most of all, betalactinin, on the basis of 6-APK, 7-ATsK, 7-ADTsK.

--Expanding the nomenclature, increasing the quantity, and improving the structure of over-the-counter medical drugs.

--Improving the quality of proudction and implementing waste-free technologies.

The main trends for the further development of the Scientific Production Combine for Antibiotics by the year 1990 will be as follows:

--A constant increase in the size of the main groups of production.

--Developing the production penicillin as the new raw material basis for semisynthetic betalactamine antibiotics on the basis of 6-APK and 7-ADTsK; during 1984-86, 880 cubic meters of new fermenting capacity will be implemented for the production of penicillin, which by 1990 will increase to 1,000 tons, and during 1985-87, 1,200 cubic meters of new fermenting capacity for the production of cephalosporous antibiotics, the production of which will reach 65 tons in 1985.

--Increasing the amount of over-the-counter drugs, improving the structure, and obtaining a higher degree of closing the cycle of production from substances to completed production.

The Plant for Microbial Preparations (PMP) in Peshtera was built as a specialized plant for the production of microbial preparations for the needs of livestock. It was set into operation in 1961, and its initial fermenting capacity was 120 cubic meters, for the production of biovit (chlortetracycline). The first large expansion at the plant, a fermenting workshop with a capacity of 800 cubic meters, began regular operation in 1970. The nomenclature of production brought about with new biopreparations has also been significantly increased.

At the beginning of 1984, the PMP has 1,184 cubic meters of fermenting capacity available and processing equipment for the production of antibiotics in a bioconcentrate form.

During 1984, the first operating complex of the new expansion at the PMP will begin regular operation, and the plant's fermenting capacities will reach a total of 2,318 cubic meters. When the second operating complex is set into operation, the PMP will have a modern chemical extractor which will permit obtaining pure antibiotic substances.

The PMP, within the system of the Farmakhim Industrial Design Organization, specializes in the production of bioproducts for agriculture: antibiotics, aminoacids, biopreparations for plant protectiong, enzymes, and others.

Scientific production service is rendered by the Development and Applications Base of Microbial Preparations. The main task of the engineering application organizations is to accelerate the implementation of leading experience, our own and foreign. In fulfilling this task, the Development and Applications Base of Microbial Preparations collaborates with the Scietnific Research Chemical-Pharmaceutical Institute and a number of other institutes at the Bulgarian Academy of Sciences, and the National Agroindustrial Union, as well as with kindred institutes in the USSR.

There is a particularly favorable conjuncture with respect to biotechnological products, at the present, and in the future. There is constant expansion in the consumption of veterinary antibiotics in those countries with intensively developed agriculture. The application of bioproducts to agriculture is the basis for meeting the production program. There are only five or six firms in the world which are the main producers of bioproducts for agriculture. Only now are some producers beginning to look toward the expanding market for these products.

In 1980, the PMP set itself a task, by implementing scientific-technical achievements and leading experience over the course of several years, to double production with the existing capacities, to carry out a progressive change in the structure of production with new, modern, highly effective bioproducts, allocated mostly for export. This task has been fulfilled successfully. In 1983, the basic economic indices of the plant increased, compared to 1980, in the following ways: commodity production, by 194.5 percent; combined profit, by 209.7 percent; net production, by 248.6 percent; total productivity of labor, by 200.4 percent; export, by 151 percent, including 200.5 percent to nonsocialist countries. This growth has been achieved practically without installing new capacities, with the same number of workers, and the same power and material expenses.

As a result of intense scientific research activity and the successful application of leading world experience, the PMP is preparing to expand its nomenclature with new bioproducts: gibbexellins, marasin, salinomycin, and others.

After completing the second operating complex, the construction of a workshop for medicinal premixtures on the basis of substances produced at the plant is planned. At the same time, the possibility of building new fermenting capacities, up to 2,000 cubic meters, to be completed with the necessary chemical purifiers, is being discussed. As a result of production intensification and the construction of the planned expansions, it is expected that the production at the PMP in Peshtera will reach 220-240 million leva by 1990, and 320-350 million leva by the year 2000.

Enzyme production in our country is developed most dynamically with the member countries of the Council for Mutual Economic Assistance. The production of alkali proteose (for the needs of chemistry for home use) has been implemented at the Plant for Enzymes in Botevgrad (later called the Medical Chemistry Combine in Botevgrad), which has a fermenting capacity of 225 cubic meters, under licensed technology and with high technical and economic results. Due to incompleteness in the technological process in 1976, however, production

was stopped. In 1980, the production of alkali proteose (in liquid form) was reinstated at the Medical Chemistry Combine in Botevgrad and the production of new enzymes, pectinase for juices, and bacterial alphaamilose for textile production has been also implemented.

Table 1 Production of basic human antibiotics in the Bulgarian People's Republic during 1970-1990 (chain index)

(base year = 100 percent)

	Production							Prognosis	
Name	1970	1975	1980	1981	1982	1983	1984	1985	1990
Tetracycline	100	150	290	350	390	415	420	585	595
Gentamycin	100	500	800	900	1100	1200	1300	1800	2000
Tubocin	--	100	300	400	450	500	600	700	900
Oleandomycin	100	250	500	1000	1200	1300	1400	1500	2000
Tylosin	--	100	3000	3200	4000	4500	5000	6000	15000
Penicillin	--	--	--	--	--	--	--	100	500
Cephalosporins	--	--	--	--	--	--	--	100	1200

The existing fermenting capacities at the Medical Chemical Combine in Botevgrad are sufficient to provide for the production of enzyme preparations to satisfy the needs of the country completely up to 1985. At the present time, however, there are only capabilities for the production of technical enzymes. The forthcoming opening of the workshop for chemical purification of enzymes will create possibilities for the production of purified enzymes. By 1985, the production of enzyme preparations such as acid proteose, mold alphaamilase, glucoamilase, lacto-coagulant enzyme, and complex enzymes such as privasin and stabilin, will be fully under way.

According to the program for developing the production of enzyme preparations during the Eighth 5-Year Plan, the amount of production should go over 6 million leva by 1985. The successful implementation of this program depends on the timely solution of a number of problems related to providing the necessary raw materials, acquiring all of the equipment for the plant in Botevgrad, and improving technological processes. The existing capacities for enzyme production at the Medical Chemistry Combine in Botevgrad are already insufficient, and they will not be in shape for satisfying, in an uninterrupted way, the increasing needs for enzymes in our country. For example, the mold alphaamilase enzyme has been successfully used in the production of bread and bread products. The needs for lacto-coagulant enzyme as a substitute for the classic rennet yeast, of animal origin, for the production of white brine cheese, yellow cheese, and European cheeses, have increased. The betagalactosidase enzyme breaks the lactose in a number of dairy products and induces a higher degree of absorption and nutritious value. A series of enzyme preparations will be used in meat production and meat processing: an immobolized complex of the catalase and glucooxydase enzymes will be used to obtain glucosodeltalacton, which is necessary for accelerating the ripening process in sausages. The enzyme pectinase is used for clarifying light fruit juices. The technically pure preparation, or a highly purified pectinase is used. The acid proteose enzyme will be used for stabilizing the clarity of fruit juices. Enzyme

preparations will be used in the starch-glucose industry with significant effectiveness. These are mostly processes related to the complex processing of corn into corn derivatives (starch, glucose, dextrines, corn extract, glucose-fructose syrup, and others). The following enzymes are used: simple and thermostable alphaamilase, glucoamilase, and glucoisomerase. The needs for the alkali proteose enzyme have increased in the chemical industry for home use.

The importance of enzyme preparations has increased sharply after mastering the technology of immobilized (linked, fixed) enzymes and the methods of genetic engineering. The achievements in these two areas have predetermined, to a great extent, the rapid development of engineering enzymology and the successes of fine microbiological syntheses of amino acids, vitamins, nucleo-amino acids, and others. The Medical Chemistry Combine in Botevgrad plans to implement basic enzyme preparations which are being produced around the world. With the present production of 4 enzymes, by 1986 their number will increase to 11, and by 1998, to 21. In this respect, the amount of enzyme production will increase 4.5 times by 1990, 6 times by 1995, and 10 times by the year 2000, on the basis of a significant expansion in existing production capacities. Real possibilities for exporting part of the production will be created by 1985, and by 1990 the export (expressed in value) will increase 1015 times, by 1995 12.6 times, and by 2000 16.3 times, compared to 1984. Our country could specialize in the production of the alkali proteose enzyme, pectinase, glucoamilase, and glucooxydase in order to satisfy the needs of the member countries of the Council for Mutual Economic Assistance. In connection with the complete satisfaction of the country's needs for enzyme preparations, an expansion of the existing fermenting capacities at the Medical Chemistry Combine in Botevgrad is being planned.

The tremendous development of biotechnologies during the last 10 years, and more specifically the development of bioengineering, has made it possible to realize the dream of a qualitatively new stage in industrializing food production. Due to a shortage of traditional raw materials during the last few years, synthetic raw materials for the biosyntehsis of proteins have been used more and more successfully. Among the synthetic raw materials, methanol is the most important, being the least expensive, water soluble, and the best mass production raw material.

The average annual shortage of raw protein (100 percent) during the Seventh 5-Year Plan amounted to 190,000 tons of livestock per year in our country alone; and it is expected to reach 240,000 tons per year during the Eighth 5-Year Plan. All this requires accelerated work on the biosynthesis of proteins in our country. In compliance with the National Coordinating Program for Proteins, the Central Institute for Chemical Industry and its coexecutive units within the system of the National Agroindustrial Union, the Ministry of Public Health and the Bulgarian Academy of Sciences, have conducted the basic technological and biomedical studies on the biosynthesis of proteins. Under the conditions of the experimental installation at the Medical Chemistry Combine in Botevgrad, over 50 tons of produce, destined for detailed tests, have been produced.

The technology for the biosynthesis of proteins based on methanol, developed by the collective at the Central Institute for Chemical Industry, is competitive with all the indices of the leading firms ICI and Hoechst, thanks to the successful combination of methanol-oxidizing and methanol-nonoxidizing microorganisms. Bilateral cooperation with the Soviet Union has been established, so that we can foresee the development of design apparatus processes design by the USSR and biotechnological supply by the Bulgarian People's Republic. During 1984, an experimental installation for biosynthesis of proteins based on methanol, with a 32-cubic meter fermentator, will be built at the Medical Chemistry Combine in Stara Zagora. Other prototypes of Soviet and Bulgarian fermentators will also be tested here.

On the basis of the accumulated experience, the creation of industrial installations for the biosynthesis of proteins based on methanol will also begin. In order to satisfy more completely the needs for industrial single-cell protein (SCP), about 100,000 tons per year will be required. Building such a capacity could be carried out gradually by consecutive construction of production lines, the first of which could be for 25,000 tons per year, and the next for 40-50 tons per year.

In accordance with world tendencies, the application of biotechnologies in the Bulgarian chemical industry will embrace more and more of the other subbranches of the chemical industry.

12334
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HEAD OF MICROELECTRONICS ENTERPRISE ASSESSES PROGRESS

Budapest OTLET in Hungarian 24 May 84 p 20

[Interview with Mihaly Sandory, director general of the Microelectonics Enterprise, by A.E.: "The Microelectronic Program From the Chair of the Government Commissioner"]

[Text] Experts worked out the microelectronics part of the central development program for electronic parts and subassemblies in the middle of 1981. Three years is a long time in this area of industry and science. One of those responsible for the realization of the program, involving several hundreds of millions, is Mihaly Sandory, who took over as director general of the Microelectronics Enterprise at the beginning of the year in addition to his assignment as government commissioner. The opening question of our interview was: Were the suppositions and the decisions based on them which started the motor of the program correct? Has not time overtaken everything which could have been thought of in microelectronics in Hungary in 1981?

[Answer] Let me say a few words about the antecedents. Our microelectronics industry as a whole was not involved. But as a result of the research and development work of the Fifth Five Year Plan there did develop the subjective conditions for the creation of a microelectronics parts industry. The organizational frameworks of it, however, did not make possible the execution of a concentrated program, because the various firms were working under contrary interest relationships and, guided by group interests, they were using up the sizable resources intended for this area. The explosively increasing importance of the products of the electronics industry in the economy and in the everyday life of society justified starting a central program. It was an important viewpoint when starting the program that we should help our electronics industry, producing 10 percent of the national income, to make the production and product structure changes which had become urgent.

We decided that in the first step we should adopt the MOS and bipolar technologies, although we knew and we know that this does not represent the peak accomplishment of the microelectronics industry. The development of the last 3 years--but especially that of last year--proves that we decided well. Despite the peak technologies developed in the area of technological development with the driving force of American-Japanese competition more than two thirds of the total production volume of the world's electronics parts industry is produced at that technical level which has gone into production here as well with the dedication of our new factory.

The increase in parts complexity has kept pace with the technological possibilities in only a narrow circle of parts; in regard to product types and value the world electronics industry has remained within the level of parts complexity planned for realization in the course of the Electronics Central Development Program.

The needs of the electronics industry have hardly changed. In addition to the "traditional" parts, printed circuits are the most important units of electronic equipment in mass manufacture. It is obvious that the electronics industry could also use IC's at a lower cost level in place of the average printed circuits.

[Question] To formulate more precisely the requirements posed by the preceding path, the degree of complexity of parts needed by the electronics industry will not increase in the next generational change as compared to the present technological possibilities, rather it will decrease somewhat. The complexity which can be handled well from the apparatus side is around a few thousand, possibly ten thousand, active elements (this figure is the result of analysis of a very broad product assortment). The economical realization of this is the determining factor within the electronics industry, the competition determining survival on the world market--this and the decision not to increase complexity beyond all limits. There is a simple reason why this is more timely here than elsewhere. In the first place we did not make large investments in another direction. In the second place--and this is more essential--the cost level for highly qualified professional work as compared to qualified skilled labor is a good bit lower here than in the developed capitalist countries, and this ratio decides the cost effectiveness of a program like the one outlined above. It is also clear from this that we will exploit our advantage--and can exploit it--as long as design automation does not significantly reduce the need for highly qualified professional work.

So, to sum up the answer given to the question pertaining to the "why": The results of the program chosen (and let me add that in my opinion only the results of the program chosen) may bring a part of the product assortment of our electronics industry to the world level. Of course this is not true of every product group, but it is true of a part of the product assortment.

[Answer] We sought an alternative solution in vain. Given the conditions of our national economy we can do microelectronics parts manufacture which is economical in itself only in this area. It gives me no pleasure to say so, but the receptivity of the electronics industry in Hungary today still lags behind what its level of development and the world market would require. Thus far the Microelectronics Enterprise has been sought out with requirements pertaining to the development of more than 100 device-oriented circuits and a large proportion of these led to the signing of a contract. There are two chief reasons for my dissatisfaction. In the first place, despite our initiatives, we have not succeeded in developing such contacts with a number of significant large enterprises. In the second place, the developmental work in the electronics industry which will determine the product assortment of the coming decade is still not based on the expected results or on the already existing results of the government program. Let me note that it continues to be true that the

equipment manufacturing industry will be able (or would be able) to exploit the achievements of microelectronics only in an appropriate environment of non-microelectronic parts.

To sum up: The microelectronics program is being realized at the planned pace, it is even ahead of schedule in a few areas. The experiences with the operation of Soviet technology and Soviet equipment are favorable; in the chip technology complex, for example, the ratio of circuits which work well is greater than planned. Significant steps have been taken in the area of expert training; the Budapest Technical University has started a microelectonics and technology department and in the Eingineering Continued Education Institute we have created the minimal conditions for the necessary further training of practicing engineers. The program can already point to significant achievements. We have linked in successfully with the parts manufacture of several CEMA countries; we have been able to increase the volume of parts ensuring replacement of capitalist import for domestic industry. We have signed our first export agreements for products going to capitalist countries. We believe that the government program is an indispensible lever for the swift development of the Hungarian electronics industry.

8984
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EVOLUTION OF THE MICROELECTRONICS ENTERPRISE

Budapest OTLET in Hungarian 24 May 84 pp 21-23

[Article by Z.K.: "What We Developed From to Become the MEV"]

[Text] The Microelectronics Enterprise (MEV) was formed on 1 January 1982 on the basis of a resolution of the Council of Ministers. The activity sphere of the newly founded enterprise embraces the activity sphere of the legal predecessor, the Signal Technology Industry Research Institute (HIKI) and of the Budapest semiconductor research and development and experimental manufacture section of the United Incandescent Lamp and Electric Company (EIVRT), today the Tungsram Company, and the entire activity sphere of the Gyongyos Semiconductor and Machine Factory, which was separated from the EIVRT on 1 January 1983.

The HIKI was founded in 1953, when most of the Hungarian research institutes were founded, with the purpose of having the previously dispersed communications and vacuum technology parts research and development activity done in a central institution. The share in industrial production of signal technology, the instrument industry, automation and then computer technology began to curve upward strikingly in the 1950's. The work of the institute was linked closely to this developmental process. After starting R and D work on light sources and electron tubes, research on passive circuit elements (resistors, condensers) began shortly, and the results achieved by HIKI in these areas appeared quickly in industry.

The first results of semiconductor research appeared in 1955 (germanium pin diodes). After that ever new technologies came to light on a continuing basis--after various sorts of germanium transistors (for example, high frequency ones) there came, beginning in 1968, silicon-based transistor technologies and types. The HIKI began research on microelectronic parts in 1965, and soon--in the framework of a national stressed target program--the development of various integrated cirucit technologies was added to its program.

By 1981 a number of technological versions of bipolar (digital and analog) and MOS type integrated circuits (IC-s) had been realized at the laboratory level and sometimes in experimental or small series manufacture either at the HIKI or at United Incandescent, in accordance with the possibilities at the time. In the early 1980's they realized laboratory production of a few highly complex integrated circuits (LCI's) on a modern technological base, which was ensured by a prototype series of members of a microprocessor family (8 bit central unit, peripheral interface, 1 K bit static RAM, 2 K bit ROM and electricity programmable FAMOS-EPROM).

The needs of the national economy were the guide in determining the research tasks, as were the corresponding central tasks designated by the KGM [Ministry of Metallurgy and the Machine Industry] and the OMFB [National Technical Development Committee]. In addition, ever increasing weight was given to the special needs appearing at the enterprises of the electronics industry. At this time they developed also the basis for computer aided IC design.

Extensive domestic and foreign cooperation had an important role in the achievements. Cooperation became very close with the KFKI [Central Physics Research Institute] and MFKI [Technical Physics Research Institute] of the Hungarian Academy of Sciences, with the TKI [Telecommunications Research Institute] of the KGM and with the Semiconductor Development Section of United Incandescent, especially toward the end of the 1970's. These resources were united in the form of a Research and Development Association, thus easing their very great investment and expert need problems.

Simultaneous with the development of semiconductor technology the development, and later experimental manufacture, of insulator-based, so-called hybrid circuits began and curved upward; at all times (even today) this work realized the technologies and types of these microelectronic products at the most modern European level. The Remix enterprise took over manufacture of the results achieved in the area of hybrid circuits--within the limits of its capacity. Smaller series or types of especially great complexity were manufactured experimentally by the HIKI. The production of equipment-oriented circuits, according to the desires of the customer, was realized first in the case of hybrid circuits and displays even today.

Research and development on measurement techniques and equipment developed necessarily in the HIKI to aid research and development on microelectronic parts. The most significant achievement in this area was the development of a computer controlled IC-measurement equipment family (with the trademark ICOMAT); since such equipment cannot be obtained from the west it enjoys very great demand in the CEMA countries.

The development of reliability tests and conducting these tests was (and still is) an indispensable part of R and D on microelectronic parts. These tests have tracked the technological and model development work to the end, both in the HIKI and United Incandescent and on behalf of outside enterprises, that is, for the enterprises that also manufacture the equipment.

The technological R and D work of the HIKI could not do without the development and preparation of various sorts of machines and equipment--primarily that which could not be obtained commercially. Among the many products we should mention the machine lines needed for manufacture of hybrid circuits (screen pressing equipment, tunnel furnaces, etc), the high purity work benches (laminar boxes) for semiconductor technology and the source devices for vacuum evaporation and cathode atomization, all of which are exported in significant quantities--in part for capitalist export--in addition to their domestic use.

The domestic history of the development of semiconductors includes the work done at United Incandescent beginning in 1957, which took place in the semiconductor development and experimental plant established at that time. Its task was

concrete model development, development of manufacturing technology and introduction into mass manufacture, making use of the results taken over from the research institutes (HIKI, TKI, MFKI). The stations of the more significant results achieved in the area of development and manufacture of semiconductors were the following:

--1957: experimental manufacture of germanium pin diodes.

--1958: development of a prototype and experimental manufacture of germanium low performance alloyed transistors (P6A-P6D).

--1959: development of a prototype and experimental manufacture of germanium high performance transistors (OC 1016).

--1964: the first industrially reliable Ge low and medium performance transistors were developed (AC 125, AC 128).

--1966: development of a prototype of a germanium high frequency mesa transistor (AF 106).

--1967: development of a prototype of an Si planar transistor (BFY 33-34).

--1970: experimental manufacture of integrated solid body circuits began.

--1971: installation of the Ge mesa transistors at the Semiconductor and Machine Factory in Gyongyos.

--1977: assembly and testing of integrated circuits started at the Semiconductor and Machine Factory in Gyongyos with Fairchild technology; cooperation in this.

--1979: experimental manufacture of TO-220 and TO-3 encapsulated semiconductors began.

The integrated circuits produced each year in experimental manufacture did not cover the swiftly growing domestic needs from the viewpoint of either quantity or variety. The creation of an integrated circuit mass manufacture base brought a substantial change in this situation. In the first step an assembly and testing plant for 15 million units per year was established in Gyongyos on the basis of a contract signed with the Fairchild firm in 1977. Within the framework of this the Fairchild firm provided the assembly and testing technology and manufacturing and testing equipment for digital, linear and general consumption circuits made with the plastic capsule bipolar technology.

The new plant was established in the Semiconductor Factory in Gyongyos. Developers from the parent factory had a significant role in setting up the factory and getting it started.

The contract made it possible for Tungsram to manufacture any plastic capsule, normal type bipolar integrated circuit appearing in the Fairchild catalog;

Fairchild undertook to deliver the circuit elements (chips) for this, but it is also possible to use chips of other origin to expand the assortment.

Gyongyos

The former Tool and Apparatus Factory in Gyongyos became the Semiconductor and Machine Factory of the United Incandescent Lamp and Electric Company in 1963. Since that time two branches have worked in the factory. The machine manufacturing branch undertook manufacture of pharmaceutical industry machines and production lines as part of the CEMA specialization effort, and then concentrated on lamp manufacturing equipment as part of the vacuum technology machine manufacture of the EIVRT. The outstanding achievements encouraged foreign customers and the workers and leaders of the factory when they moved on to new areas of glass industry machine manufacture. After the high performance flanged glass manufacturing and hollow ware manufacturing machines, several hundred tumbler grinding and painting machines left the factory. The electronics ministry of the Soviet Union played a determining role in the machine manufacture; it asked the people at Gyongyos for manipulators used in the manufacture of television picture tubes. Thus far they have manufactured a total of nearly 1,000 of the advanced manipulators, which can bear a load of 25 kilograms, several versions of suspended robots manufactured taking into consideration other needs, a robot serving a stamping machine, with a load capacity of 5 kilograms, and automatic sorting and feeding devices for integrated circuits.

Mass manufacture of modern semiconductors began in Gyongyos in 1963, the year they joined United Incandescent, when two production lines to assemble tungsten pin diodes were put into operation. They have manufactured some 500,000 gold pin diodes and OC 1044, 1074 type transistors. A three-story semiconductor manufacturing hall with a total area of 4,000 square meters was finished in 1971. With this investment Gyongyos became the base for semiconductor manufacture in the country. The manufacture of high performance transistors and the modern technology demanded the planning of production control and materials and parts management, so the semiconductor manufacture was linked into the computor system of the large enterprise.

Installation of the plant that assembles bipolar integrated circuits, purchased from the Fairchild firm, began in 1977 and was completed within one year. Soon the high level IC-manufacturing technology and the fact of a reliable machine manufacturing robot family provided an occasion for the coming together of the two branches. Replacing the previous pneumatic control of the robots with electronic control resulted in a qualitatively new and more economical product. The electronic controls for the robots were manufactured in Gyongyos, using their own semiconductors. Planning and implementation resulted in the cooperation of the two manufacturing branches; as a result of the joint work these products have gone to 26 countries throughout the world, enhancing the good reputation of Hungarian industry.

The MEV

The basic task of the MEV is to supply domestic manufacturers and users with microelectronic parts and subassemblies and research and development and

manufacture in the area of microelectronic technologies, measuring instruments and special purpose equipment. Since the level, mass production and cost-effectiveness of parts manufacture increasingly determine the modernity of equipment manufacture, the government program has set down the medium-range tasks accordingly. The goal of the program is to develop an economical product structure for the electronic parts industry, having its productivity and technical level gradually catch up to the international level. The developmental goal prescribed in the already mentioned Council of Minister's resolution is research and development on and mass manufacture of microelectronic parts, and beginning in 1985 marketing also will be realized within the organization of the enterprise. In order to strengthen the research and development possibilities of the enterprise the mask preparation section of the Central Physics Research Institute was attached to the enterprise in May 1983. The characteristic operational and manufacturing areas of the MEV today are:

--custom-made semiconductor devices; diodes and transistors;

--integrated circuits (up to LSI complexity), including the design and manufacture of equipment-oriented IC's;

--manufacture of special, custom-made devices; for example, liquid crystal displays, acoustic surface wave filters, semiconductor sensors, and elements to sense and measure light, heat or pressure;

--hybrid integrated circuits; highly complex catalog types and types suiting customers; wishes;

--automatic measuring devices; computer controlled measuring systems, automatic measurement devices for integrated circuits and automatic testing and classification devices for passive parts (resistors, potentiometers, selenium blanks, etc);

--industrial manipulators and robots; and

--manufacture of technological equipment (for example, electron ray vaporization, magnetronic atomization, screen pressing equipment, tunnel furnaces, etc) and glass industry equipment (for example, ampule manufacturing, pharmaceutical industry filling-sealing machines, automatic glass grinding equipment, etc).

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MICROELECTRONICS TRAINING DEEMED INADEQUATE

Budapest OTLET in Hungarian 24 May 84 p 30

[Article by T.K.: "Is Enthusiasm Enough?"]

[Text] It is as obvious as one times one--not only in sports but also in industry one can achieve nothing more than cheap, temporary success without suitable replacements. Well before the birth of the government electronics program, in 1975, there were experts who voiced warnings in this matter as well, and although they did not remain without a response we cannot say even today that the replacement of electronics experts has been solved.

They began to teach semiconductors in the 1950's in the only electrical engineering school in the country, at the Budapest Technical University; at that time outstanding personalities still considered the whole thing a fad. In the decade which followed the experts could become acquainted personally with computers; slowly, and outside the study plan, more and more was said about computer technology. In another decade the new concept became a subject of study, even if at the time the great majority of the students for a good while yet could practice the programming languages only with paper and pen. Electronics also demanded for itself more and more room in school and there was an increase in the knowledge which again could not be forced into the frameworks of the subjects offered. Prior to the long awaited government program, in 1980-1981, they began to work out new study plans and the theory of microelectronic devices and information about their manufacture became organic, separate parts of them. First, the institution which had been called the Signal Technology and Instrument Industry Technology Faculty for 20 years became the Electronics Technology Faculty and then, with the new study plan, they formed the Microelectronics and Technologies School. Thus, even if not in a regulated bed, the science of microelectronics gradually trickled into the university. Every year there were 30 or 40 beginning their careers as electrical engineers who could go into the practice of microelectronics armed with the theoretical information.

Today, 60-70 young people graduate each year from the two faculties dealing most with microelectronics. Naturally, there is a good bit broader circle of those who become acquainted from the aspect of use with control technology or computer technology as future users or as future mechanical engineers. For a long time the latter were forced to use a paper and pencil instead of computers (a few specialities are an exception, where even today the tasks are inseparable

from a computer), so the swift spread of microcomputers is a blessing. The approximately 50 graduating engineers who study electronics manufacture and development could browse through the positions advertised by so many enterprises in evidence last year; but this does not mean the placement possibilities are good. Every year the enterprises offer about five times as many positions as there are electrical engineers graduating. A large part of this is poorly thought out over-insurance; even today there is a strong industrial view which does not concern itself with special training--all that is important is whether the applicant graduated in the area of weak or strong current. It is characteristic that in the competitions enterprises seek people to manufacture electronic parts where at most the only thing which might be involved is use of a computer.... The low pay of engineers beginning their careers is well known; the enterprises today are offering 3,500-4,000 forints as a beginning wage. Thus, except for those on social scholarships, only a fraction of the so-called free students apply to the enterprises. With the end of the compulsory competition system the university lost every possibility of tracking the path of young people graduating, but it is a general experience that the young engineers go more gladly into agriculture, to the small undertakings or even are placed outside their speciality.

Another sort of university "antenna" works much better than this--the day-training for special engineers. In this form the enterprises, as it were, put out their fresh experts to the university, people who get special professional training for another two years without leaving their school desks. The advantage of this is that the students and instructors are now well acquainted with the goals and themes of the enterprise so they can talk about more concrete things. But this is good for the students too, because they can prepare even to get a doctorate with greater material security, without struggling for a livelihood. At the university they say that interest in this sort of thing is very lively; each year ten special engineers graduate from the two faculties, and most of them go to the Microelectronics Enterprise.

At one time the attractive and easily chosen path for the fanatics was to remain at the university as instructor-researcher. Today, however, the prescriptions make this too difficult; one can compete for a position as university assistant professor only after 3 years of practical work. One really has to be a fanatic to do this. Those affected also complain a lot because of the material situation of the faculties. Dr Andras Ambrozy, leader of the Electronics Technology Faculty, has been working at the university for 3 years.

"The most modern microelectronics are so expensive," the faculty leader said, "that even in the most developed countries the educational institutions can follow industry only pretty far behind. In addition, we cannot use the equipment to the degree that an enterprise can--so it is partly understandable that we are in a bad position in the matter of tools. In the United States in 1976 they proposed that the work of designated universities be concentrated at a higher level with the cooperation of industry. At this time we also received significant sums from the developmental funds of the enterprises, but later these sources dried up. To put it modestly and not counting the lost years, we would need at least three times as much money as there is today to maintain a suitable level and follow modern technology. It frequently happens now that

we give up investments long postponed and use the sum freed to buy, for example, Spectrum computers. Our situation is even worse in the acquisition of information; in the recent past some mysterious power, shoving aside every professional requirement, dangerously cut the sums which can be spent on journals. So it is very difficult to get important information. But even more painful than this is the matter of foreign travel. Except for restricted institutional contacts not involving foreign exchange, our experts can travel only with all sorts of intrigue, sometimes under the guise of other firms."

A suitable level of replacement of high level experts is very important, but for this reason we should not forget about the other levels either. Skilled worker training takes place in the secondary trade schools, the tests to qualify technicians are based on this, but not anywhere near according to the need. Neither the expertise of the young people graduating from the secondary schools nor the number of reclassified technicians reach the requirements of industry. As a result of this a large part of the factory engineers graduating from the Kalman Kando College are forced to carry out the tasks of mid-level technicians, so their wages are lower than expected--and thus, understandably, they feel bad in this situation. The college is neither higher level nor mid-level and the secondary trade schools cannot train mid-level cadres.... So it is not accidental that many are urging the reinstitution of "technikum" training. A Council of Ministers resolution to this effect exists already, but execution is still awaited. Electronics study plans, among other things, are being prepared in the Ministry of Industry this year, but to create all the conditions they must win the county councils' support for the goal, obtain school buildings, etc. In the best case, day technician training in the spirit of the resolution might begin next year, but many fear that this time limit will be modified. At best, the new technicians will appear at the enterprises in 1990.

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TETENYI: INTERNATIONAL COOPERATION ALONE CAN BRIDGE TECHNICAL GAP

Budapest OTLET in Hungarian 28 Jun 84 p 16

[Interview with Pal Tetenyi, chief of the Scientific Education and Cultural Department of the Central Committee of the MSZMP, by Janos Ban: "Not Only a Question of Money"]

[Text] Roughly 38,000 of the half million residents of the country who have university and higher degrees are scientific researchers and developers. In 1983 the country spent 23.5 billion forints--3.2 percent of the national income--on research and development purposes; of this the sum available for research alone came to 6-8 billion forints. 1983 was the first year in which the research expenditures decreased by roughly one billion forints--outside the research sites.

The guest of the most recent "Sixtysix" program, Academician Pal Tetenyi, chief of the Scientific Education and Cultural Department of the Central Committee of the MSZMP, answered questions which were not aired on the program.

[Question] Will not the reduced technical development and smaller material possibilities increase our technical backwardness compared to the developed countries?

[Answer] In recent years the technical gap between our country and the developed industrial countries has increased in general; but I would stick to a single, concrete area which is closer to my interests and expertise, the production of research instruments. One can really and unambiguously demonstrate our backwardness in the manufacture of research instruments, so the backwardness of the country in the use of instruments used for scientific research has increased in the past decade. There are a number of reasons for this. Our instruments enterprises are too powerful to undertake the manufacture of individual instruments. One might be able to sell five or ten of them, so it would be only a small series. The other reason is that the country does devote a significant part of the national income to research--maybe, if it could, it would devote even more--but while the research and development expenditures of our country make up only a few thousandths of the world's total for such purposes the product

palette of the country even today makes up more than 50 percent of the products of the world. The technical gap can be bridged only with the aid of international cooperation.

[Question] What sort of connection is there between the takeover of new technical information and enterprise size? This is all the more important because 59 of the 66 called to answer the question of where the greatest gap is between science and practice voted for industry...

[Answer] Of course, this vote did not refer primarily to enterprise size, but let us begin with this. A small enterprise, whose own developmental section is weak and which has no research capacity, finds it very difficult to deal with the tasks accompanying the introduction of new achievements. Let me give an example. I think that something like this happened with the magic cube, because it appears to me that the artisan cooperative, which did make praiseworthy efforts in the interest of introducing this sought-after product quickly, was not prepared for the task in either its organization or its marketing system. The other extreme is when the enterprise is too large. I gave an example of this, the research instruments.

There is no doubt that we cannot be satisfied with the fact that the distance between science and practice is greatest in industrial production. University education and the research institutes have things to do in this also. But we know enterprises, and fortunately their number is increasing, where the atmosphere favors introduction of the new. One can expect a strengthening of this primarily from an increase in competition. But there are also enterprises which pay no attention to the new. An enterprise in a monopoly situation, for example, which produces for a shortage market is not sufficiently forced to develop. A counterexample is the pharmceutical industry, which has spent a lot on research for decades and is developing its products. We should develop a regulator system--and hopefully this is happening--which better encourages the introduction and use of new achievements.

[Question] One letter writer asks: Is the money available being given for purposes which are really needed, and what role do connections have in awarding the money?

[Answer] At present the larger half of the research and development funds can be found in enterprise hands. Not quite one fifth comes from the state budget and almost 30 percent is the technical development fund for central guidance organization. I list things this way because the practice in general is that those charged with a definite goal use the various sources--central and enterprise funds--in combination. Common financing presumes a common interest. Guidance is trying to aid this rational process by seeing that research institutes and the universities get commission which the enterprises are interested in introducing.

As for the other half of the question, personal motives do play a role in awarding the money too. This cannot be condemned out of hand, but let

us immediately add that unprincipled friendship and protection should be condemned unambiguously. It is certain that there are such things among the many thousand research commissions and action must be taken against this.

[Question] How can the research institutes be made better interested in handing over the results?

[Answer] It is the task of guidance to introduce an incentive system which will make the research institutes better interested in the income coming from the introduction of results. A way to realize this might be to have the research institute and the enterprise sign an agreement according to which the enterprise will not pay the research costs independent of results but rather will hand over a certain part of the profit.

[Question] According to a proposal of one letter writer we should establish an office which will guide and if necessary oblige the enterprises to take over the research results?

[Answer] Such an office would accomplish nothing. The solution is much simpler and more obvious--we must create a common interest, and then the mechanism would work undisturbed.

[Question] It is well known that the instrumentation of research sites in our country lags behind our needs, but at the same time the utilization of instruments is rather low...

[Answer] It is difficult to say what the most efficient degrees of utilization of an instrument or piece of equipment is. It would be really good if, at the central service units, they were to work in three shifts and use the fourth shift--only there is no such thing--to see that the instrument remained operable. In the case of central instruments the utilization in general well exceeds one shift, but this could be increased. But there are places where this is not possible and we must be content with the present utilization.

[Question] Several asked the question. What does being a scientist entitle one to? How do you judge the structure of our research network?

[Answer] Let us begin with the structure of our research network. I am convinced that if it were our task today to organize the research network of the country we would not do what our predecessors, our professors, did at the end of the 1940's and beginning of the 1950's. We would not put so much emphasis on the research institutions having research as their chief function; rather, we would build much more on the research taking place in the university faculties and at the enterprises.

The second question refers to scientific qualification. When the still valid form of scientific qualification was introduced a good 30 years ago it was a very rational incentive system in the interest of research and development. As I see it today--and this is my personal opinion--we need a different system of scientific qualification, for example, a single

stage qualification. In my opinion the present scientific qualification is good for one thing--the same thing as a university diploma, only at a higher level. It proves one thing, that a person who gets a scientific degree proved that he was capable of independent scientific activity at the time he got the scientific degree. The rest of the hierarchy does not mean much. The country today has something like 1,200 doctors of science, who worked honestly for this degree. The stamp of the Hungarian People's Republic is there on the diploma. It is not possible for anyone to announce that beginning tomorrow these scientific degrees do not exist. We cannot do this, although it may be that today this would be more rational.

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MARKET RESEARCH OFFICIAL ON ELECTRONICS, COMPUTER TECHNOLOGY

Budapest PENZUGYI SZEMLE in Hungarian Jul 84 pp 519-525

[Interview with Zoltan Tompe, engineer-economist, of the National Market Research Institute, by Ivan Wiesel, journalist: "Computer Technology--Electrotechnology"]

[Excerpts] [Question] What sort of change took place in the branch after the "year of the turning"?

[Answer] At the beginning of the 1970's, when we began to look at the world market, we found that our electronics was an average of 10 years behind the world level, 20-30 or even more years behind in some areas. From the middle of the 1970's it gradually became clearer that the requirements level was increasing on the markets of the CEMA countries also, that a certain achievement in the development of the electronics industry had matured in the socialist countries, which created a new competition situation.

[Question] What are the practical consequences of the spread of the microprocessor?

[Answer] In the beginning we could meet with a vigorous convergence within electronics as a result of microprocessors. This means that in regard to their technical structure and control principles the signal technology, computer technology, automation, office electronics, medical electronics, amusement electronics and household electronics devices were approaching one another strongly. Later, microprocessors appeared in virtually every area of life, and this process is continuing today. Only imagination puts a limit to the application of microprocessors today. The technical possibilities are greater than the use needs of the moment. In connection with electronicalization and home hobby computers we can again hear the same voices which spoke at the time of the invention of the appearance of book printing of superfluous, senseless fads in the best case or of the contamination of mankind in the worst case.

The computer technology culture differs greatly from country to country. In the United States today one can find 20-22 microprocessors in an average household--in alarm systems, telephones, washing machines, microwave ovens, hobby computers, home bank terminals, TV sets, video recorders, home hi-fi sound systems, automobiles, etc. I could list thousands of possibilities

for the use of microprocessors and of computer technology in general, but I think this would be superfluous for the popular scientific press reports every day on every new ingenious and sensational applications possibilities. I would speak of only one thing. It counts as a rarity throughout the world today, with the exception of Japan, but robot technology will spread generally in this century. In Japan there are already completely automated factories in the machine industry, automobile industry and textile industry. This means that the final product appears in final form without being touched by human hand, that robots perform every existing production task. In 1982, 72 percent of all the robots in the world, more than 33,000 of them, were operating in Japan. At the same time, fewer than 8,000 took part in production in the United States, 2,300 in the FRG and only 2,760 in all other countries of the world combined. The price of a universal programmable robot equals 2-3 years average pay for a worker. The repayment time for robots is already only 2-3 years. In addition one can expect a further technical perfection of robots and a reduction in their price.

[Question] It appears from what has been said thus far that in practice the expansion of computer technology and electronics in the world is the privilege of one or two leading countries. What do small countries have to look for in this branch of industry?

[Answer] Thirty-two percent of the use of electronic devices is concentrated in a single country, the United States. Per capita consumption there is $490 today. In Western Europe it is $264. The world average at this time is about $90. The following per capita consumption is predicted for 1991: United States, $940; Western Europe, $610; and the world average, $192. The predictions expect an increase in the consumption-use gap in this century. The concentration in production is even higher. The United States provides 37 percent of the world's electronics production. The share of the United States, Western Europe and Japan combined is 83 percent. But one must see in the development also that there are not only mammoth firms on the market; indeed, even technical novelties are not the exclusive privilege of the big ones. In many respects flexible small and medium firms have an advantage over the large ones and adapt outstandingly to the special requirements of the market gaps; indeed, sometimes they even appear with epochal novelties. (See, for example, Intel, Shugart, etc.) There are possibilities for smaller firms and smaller countries too, if they make use of their conditions and surpass the big ones in flexibility and adaptivity. So the situation of the small countries in the competition is not hopeless either.

[Question] Where is our country?

[Answer] It well indicates our backwardness that our per capita electronics consumption is $40-50, or about half the world average. The relative development of our electronics lags a good bit behind the general relative development of our economy. But electronics is not simply one of the branches of industry, it is the carrier of the new industrial revolution. From the viewpoint of the future our electronics situation will be more determining than the general level of our economy. It is not possible to give a precise answer to the question of how many years we are actually behind. The first question which arises immediately is: Compared to what? Compared to the

developmental achievements of the leading world firms, to the average level of the chief developed capitalist markets, or to some sort of world average? Firm? Market? Product? We have a few custom-make export products which represented the average technology of the chief capitalist market only 3-5 years ago. And we have electronic devices and services which represent the developed capitalist level of 1950. Our telephone exchanges which were modern in 1926 are still in operation. I might say that in general our devices follow an 8-10 year old level; the gap is greater in the area of uses, in electronics culture. But these figures are misleading, because they presume that we are following the same path and it is only a question of time before we reach the same level. This is not true however. We are not following the same path, and in itself this is not a problem. We could make up 10 years of backwardness in 3 years or in 30. It is relatively easy to make up for the technical backwardness of concrete electronic devices. The gap can be narrowed by purchasing licenses and know-how. Narrowing the gap is much more difficult in services, in general electronics culture or in the social prestige of electronics and its experts; even reducing the rate of its growth is not a simple task.

[Question] What is the cause of this great difference?

[Answer] I consider the economic causes the most important. Within these I would talk about the causes in economic policy and in the economic mechanism. For a long time economic policy forced electronics, primarily computer technology and ammusement electronics, into the background. At the beginning of the 1950's, in the land of Janos Neumann's birth, it was felt that cybernetics was a bourgeois pseudo-science. As for the causes in the mechanism, even today we have not succeeded in finding an economic mechanism which would ensure the adaptivity of the economy, flexible adaptation, a swift take-over and application of modern technologies.

[Question] A number of electronics parts manufacturing programs have seen the light of day since the beginning of the 1970's. What was the fate of them, how did they help reduce the backwardness?

[Answer] Since the beginning of the 1970's, 25 plans have been prepared for the reconstruction of the electronics parts manufacturing industry. Since all the affected organs had to give their opinions on the several plans, they became obsolete, and one could begin preparing the next plan conception. The developmental pace of technology had no respect for the elaborate Hungarian way of doing business, so the world market backwardness increased. Finally, the Council of Ministers accepted the 25th plan in December 1981. The Microelectronics Government Program adopted was formulated under world market, financial and economic conditions a good bit less favorable than had been planned earlier, and its goals were more modest accordingly.

[Question] Where are we today in electronics parts use and manufacture?

[Answer] The Hungarian manufactuers of electronic devices use 2,000-3,000 types of integrated circuits. The only Hungarian manufacturer of semiconductors, the Hungarian Electronics Enterprise, is capable of manufacturing 150-200 types of integrated circuits, and for the time being the good bit more expensively than the world market average. And one of the biggest problems of electronic device manufacture is that it is not competitive in price.

[Question] Why are we more expensive than the world market?

[Answer] I did some calculations to analyze the causes. These appeared in the February 1982 issue of VALOSAG. The Hungarian manufacturers of electronic end products get materials and parts for nearly double, as an average, what their capitalist competitors do. The prices of the parts of the socialist countries are 1.8-2.3 times the world market average. Domestic parts are frequently even more expensive. There is hardly a possibility for capialist parts import, but even the few imported parts are burdened with high duties. The manufacturer of an electronics end product finds that a parts dollar costs him 80-100 forints while they demand of him that he produce 1 dollar for 40-50 forints. In addition, the cost of central administration and the cost increasing effect of business costs and other incrustations are rather well known. We might recognize the most essential causes of the uncompetitive nature of our production prices if we dispelled a few myths. The first of these is the myth of cheap Hungarian labor. It is not that Hungarian labor is cheap but rather that Hungarian wages are low. In the electronics industry the workers, technicians and engineers of our capitalist competitors, people with the same level of training, get pay 15-20 times higher than their Hungarian colleagues. Unfortunately, however, this difference does not appear in the final product. The potential advantage deriving from the lower wages disappears completely as a result of substantially worse efficiency, the lower technological level and the weaker operations and work organization; indeed, the average labor cost per product will be greater for us. In the leading electronics enterprises of the world the production value per capita is $50,000-60,000. In our electronics enterprises, according to my estimate, the per capita production value in a year is $8,000-12,000. I would mention second the Hong Kong myth. This follows directly from the first. We hold sharp pseudo-debates about whether we can undertake the role of Hong Kong on the basis of the cheap Hungarian labor, undertake humiliating capitalist jobs or the large series manufacture of medium quality, cheap commonplace products. But even today wages make up only 2-5 percent in the price of the most modern electronics products. Automation has reached such a level that technology is much more important than the price of labor. Behind the success of Hong Kong and its fellows (Singapore, Taiwan, South Korea, Malaysia, etc.) one finds the import of capital and the ability to swiftly adapt modern technology. Even in these countries wages are not so legendarily low. The third is the develoment myth. Our capitalist competitors are offering ever more complex services with ever more modern equipment at ever lower prices. We say, let the customer pay for more service and greater performance. For us a new development means a price increase, but most of the time costs should decrease for new, more modern, lighter and energy conserving equipment. The enterprises prefer to use the very significant sums intended for technical development for communal purposes, to retain or entice workers or as wages supplements in kind. If there is no possibility of increasing wages because of central restrictions then at least they can try to retain workers with nurseries, resorts or housing construction support financed out of the technical development fund. In general the sum intended for modernization of production equipment is a small part of the technical development money. Every single electronics enterprise maintains an extensive developmental apparatus, for then it can account for significant sums under the heading of

technical development. Large, slow, inflexible and expensive developmental organizations come into being at virtually every enterprise. The fourth is the profit interest myth. Our capitalist competitors have much greater freedom in regard to the distribution of their profits. They may turn 30-37 percent of the profit to material incentive, shares or wage increases. According to my calculations shares make up 3-5 percent of the profit at most even in the best case for us. A capitalist firm may spend 200-300 percent of the profit on development and new investment, together with the credits assumed on the profit. Here a maximum of 20-25 percent of the profit can remain at the enterprise for developmental purposes. For us the material source for technical modernization within the enterprise is not the profit but rather technical development calculated as a cost. In the strong competition struggle on the world market profit is the only possibility for survival and it can be achieved by constant modernization of the products and constant reduction in the costs. It is only a myth that this is the essence of profit for us. Naturally profit is important for us too, but primarily because of the external judgment, a good reputation and preferences, not because of its economic essence. For us profit is only a beauty-spot, not the basic condition for survival. The primary interest of the enterprises is to maintain the domestic and socialist shortage markets without real competitors, which is ensured by the stop on imports.

[Question] Electronics is extraordinarily investment demanding. The manufacturing lines are increasingly automated, manufacturing machines are exchanged every 2-3 years due to the incredible speed of moral obsolescence. Is it worth it for us to undertake to develop such a branch of industry?

[Answer] The truth is that the smaller the material to be worked the greater and more expensive the equipment needed to work it. Technical development is accompanied by extraordinarily high costs and even in the case of the most developed multinational enterprises it cannot do without significant state support. Research reaches down to the level of basic research. Two of the 19 research institutes of IBM deal exclusively with basic research. But there is another side to the matter too, namely that we have no choice, we must deal with electronics. We had no choice with the appearance of book printing either, we had to master the technique quickly and make it an organic part of our life. Naturally there is no sense in planning an independent electronics manufacturing vertical structure, competing with Japan and the United States, but we can find market gaps where we can fit in and integrate into the electronics world market. With our own manufacture and export of certain products we can lay the foundations for a swift domestic spread of the use of electronics and prevent our being broken off from a world which is becoming electronic.

[Question] According to you microelectronics will pervade every country in the world and even become a society-forming force in our age, but especially in the coming decades. This is why our country must link into this process as soon as possible with correct adaptivity.

[Answer] That is what we are talking about. There is no doubt that microelectronics will make the realization of new guidance systems and styles possible. Indeed, it not only makes possible but demands a new way of thinking, a new method of guidance. We must note also that microelectronics will have a great effect on social movement and changes. Even today the social sciences should be dealing wisely with the social effects of microelectronics to be expected.

[Question] I recently read an article by Academician Tibor Vamos about the development of the systems of cybernetics. As a result of his analysis of development the author states that the path of the future is the cooperative working together of decentralized systems. What is your opinion about this idea?

[Answer] In an extraordinarily interesting article by Tibor Vamos in issue No 4, 1983, of VALOSAG we can read that the advantages of cooperative systems are facts proven in practice, that in more and more areas the present, not only the future, belongs to cooperative systems. Although Academician Vamos emphasizes that the development of cooperative systems is not an exclusive trend and that system states exist in which a cooperative organization is at a disadvantage compared to a centralized and hierarchic organization, still he argues definitely for the development of cooperative guidance systems. That article contains extraordinarily sympathetic and important ideas. I think that in economic life we have come already to a recognition of the obsoleteness of the directly centralized guidance method, and our economic reform has led us to a heirarchically organized, decentralized guidance system. We must go further in economic guidance toward cooperative, distributed guidance systems. This is the greatest lesson of the Vamos article for me.

[Question] What technical novelties do you expect from electronics by the year 2000?

[Answer] It is extraordinarily difficult to prepare such forecasts, because an invention may appear at any time which may bring a radical change in the direction or speed of development. The astounding achievements of electronics in the 1970's could not have been foreseen--not only in 1950 but not even in 1968. Who would have thought, in the 1950's, of microprocessors, pocket calculators, optical fibers, satellite communications, industrial robots, video recorders, personal computers, etc.? Starting from current research I would select 10 technologies the spread of which we can certainly count on by the year 2000. These are voice recognition systems; interactive household information systems in which the home computer, viewdata, electronic mail, cable TV, etc. will function in a single, integrated system; large screen, flat displays with outstanding picture quality; gigabit logic, or chips with a capacity of a billion bits, possibily on a gallium-arsenide base; fully automated factories; electronic phototechnology; laser disk technology; the spread of videophones (picture screen telephones); automatic interpreter machines; and vehicle remote control.

[Question] What is your opinion about artificial intelligence? Can a machine be made in the near future whose capabilities can be compared with the human brain?

[Answer] In many respects computers have gone beyond the capabilities of the human brain already. For example, they can calculate much faster and more precisely. Even before the year 2000 we may reach a level where we can integrate as many elements as there are nerve cells in the human brain into a space the same size as the human brain. But we will not make these elements operate intelligently in the foreseeable future. We have not even understood the essence of intelligence so as to reproduce it. In any case, we are going in the opposite direction. We are building systems whose functioning can be calculated in advance whereas human reactions, as you know, are completely incalculable in many cases.

[Question] Finally, where can our country be placed on the microelectronic development map of the year 2000?

[Answer] I think that our unfortunate backwardness will increase further in the 1980's. By the beginning of the 1990's we may succeed in a stable integration into the world market, but probably at a lower level than we would like. Unfortunately, our earlier economic policy and mechanical errors and especially the material and moral devaluation of the technical intelligentsia will make their effect felt for a long time; it is very difficult to correct the mistakes, change step and make up the lost time. In the best case we may catch up in the second half of the 1990's, in the last years of the century. I think that it is better to face up to this and define our plans in these steps.

The problems of Hungarian electronics are not technical but rather economic ones. It reflects a bad view if we argue only about whether to develop this and not that, spend this much but not that much. The number one task is to develop the economic mechanism so that the economy--and the electronics enterprises therein--will be capable of quick, flexible adaptation, taking over, integrating and applying creatively the new techniques and technologies. A way to do this is to take over the advantages of distributed cybernetic systems in economic guidance.

The electronics industry of every country needs stressed government programs and central development plans. It appears that electronics is getting a stressed position in our industrial policy strategy, and this is very reassuring. But this must be supplemented with an economic mechanism-encouraging adaptivity. As I mentioned already, there are gaps on the world market which Hungarian electronics may be capable of filling. With selective development, flexibility and good quality even small firms and small countries can find their place in the shadow of the large ones. Danish electronics, for example, is first in the world in the area of acoustical measurement. Even today electronics has areas and there are factories in Hungary in which we are capable of performance approaching the world level. In these few areas not only our expertise but also our efficiency and even our quality

are comparable to the average of the developed capitalist countries. In addition to a few special research and software areas, a number of producing plants also belong in the narrow efficient band of Hungarian electronics. This band gives hope and confidence regarding the future of our electronics. If we concentrate strongly on this band then we can joint actively into the electronic blood stream of the world and will be not losers in but rather beneficiaries of the new industrial revolution.

8984
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ADAM & EVA, A SYSTEMS DEVELOPMENT DESIGN AID

Budapest IFORMACIO ELEKTRONIKA in Hungarian No 2, 1984 pp 63-69

[Article by Dr Bela Halassy, a chief scientific worker at the SZAMALK, Computer Technology Applications Enterprise; received for publication 18 Sep 83]

[Excerpts] The article describes the ADAM & EVA data and procedures modelling aid, which is new in its principles and modern in its realization. It describes the system in detail in regard to concept, rules and procedures. For systems development the ADAM & EVA is a tool with which one can do modelling on analytical or synthetic principles based on either data or procedural structures. Indeed, it is even possible to change the strategy of design in the course of building the system. Emphasizing the new aspects of ADAM & EVA, it compares it with other known tools and principles and turns to the possibilities of its application.

In our brief introduction we described a systems development aid. We pointed out the need for computer support for development and those new design principles which increase the effectiveness of this support. We defined briefly those basic concepts on the use of which the ADAM & EVA data and procedures modelling system is based. We outlined the rules to be followed in preparing optimal models, referring to the services of the aid which it offers in implementing these rules. We touched on the possibilities of various modelling procedures. After an overview of the program system of the aid we turned to the most important technical conditions for applications. In the course of development of ADAM & EVA we drew a great deal from experience gained in practical application of the SZIAM data modelling aid. But the new system does nt resemble its "predecessor" in its principles, mode of operation or technical conditions. It is substantially more flexible, has more capabilities and, not least of all, its use requires less machine time. The new modelling tool realizes practically every principle which Dr Bela Halassy set down in his book titled "System Development Based on Data Modelling" (SZAMALK, 1983). The bibliography of this publication contains the basic sources.

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HUNGAROVOX--A REAL-TIME INTERACTIVE HUNGARIAN SPEECH SYNTHESIS SYSTEM WITHOUT DICTIONARY

Budapest INFORMACIO ELEKTRONIKA in Hungarian No 2, 1984 pp 98-111

[Article by Gabor Kiss, programming mathematician, and Gabor Olaszy, electrical engineer, of the Linguistic Institute of the Hungarian Academy of Sciences; received for publication 11 Nov 83]

[Excerpt] The HUNGAROVOX speech synthesis system described in the article, developed for industrial use, represents a significant achievement of research in Hungary directed at artificial production of speech. The software and hardware of the system were developed in the Linguistic Institute of the Hungarian Academy of Sciences. With HUNGAROVOX one can transform into speech in a real-time mode text given with Hungarian orthography with any sort of content and of unlimited extent in time. The degree of compression of the artificial speech is about twenty fold, its quality is good on the basis of perceptual tests and the text spoken can be understood well. HUNGAROVOX, as a speech system, can be used well in controlling industrial processes, in education or in information communication systems.

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THE IBCDASDI PROGRAM AND CONNECTION OF DISK PACKS WITH 100 MB CAPACITY

Budapest INFORMACIO ELEKTRONIKA in Hungarian No 2, 1984 pp 112-120

[Article by Peter Bencsath, of the General Organization (Main Department of the Industrial Informatics Center, and Tibor Sandor, of the Signal Technology Electronics Institute of the Budapest Technical University; received for publication 4 May 83]

[Excerpt] Surface analysis initialization (giving initial values) of 100 M byte capacity magnetic disk units is possible only with the system-independent auxiliary program provided by the factory, the IBCDASDI. The physical operation of the disk drive units gives reason for the circumspect use of this program. By publishing a detailed study of the program the authors want to put an end to the uncertainties surrounding initialization.

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DIAMS OPERATING SYSTEMS ON MCS COMPUTERS

Budapest INFORMACIO ELEKTRONIKA in Hungarian No 3, 1984 pp 144-148

[Article by Szabolcs Benedek and Jozsef Hollendus, of the Fejer County Water Works; received for publication 18 Jan 84]

[Excerpt] After a brief, historical survey of the DIAMS operating systems, which are also used on MSZR [minicomputer system] computers, the authors provide a listing of the most important systems programs for DIAMS 1 and then discuss in detail the characteristics of the newer DIAMS 2 (DSM) system--primarily in regard to areas essential from the viewpoint of development.

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GPSS-F, A FORTRAN-BASED PROGRAM PACKAGE SUPPORTING DISCRETE SIMULATIONS OF SYSTEMS

Budapest INFORMACIO ELEKTRONIKA in Hungarian No 3, 1984 pp 150-157

[Article by Dr Istvan Molnar, of the State Administration Computer Service of the Central Statistics Office, and Gabor Pali, of the Financial and Accounting Academy; received for publication 4 Jan 84]

[Excerpt] At the end of the 1970's, in a period of development of so-called combined simulation software simultaneously supporting both discrete and continuous simulation of systems, the report of the development of GPSS-F, a FORTRAN-based discrete simulation program package, was a surprise. The GPSS/360 and the FGPSS served as a basis for the development and the generally accepted FORTRAN IV was chosen as the basic language. The program package was further developed within a short time and today has been installed in more than 1,000 places. The purpose of the article is to describe the characteristics, advantages and practical use of GPSS-F with the aid of an example.

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TELEDATA SYSTEMS

Budapest INFORMACIO ELEKTRONIKA in Hungarian No 3, 1984 pp 170-173

[Article by Dr Ivan Solt, software theme leader for SCI-TEL; received for publication 24 Aug 83]

[Excerpts] Summary

The introductory part of the article describes the general characteristics of a new branch of information technology, a system known in Hungary under the name TELEDATA. It then describes the basic developments taking place in this area at the Computer Technology Coordination Institute. On the basis of experience acquired as a user with the Siemens in-house Bildschirmtext system, it describes the structure of closed TELEDATA systems (based on an ESZ 1015 minicomputer and an M08X professional personal computer), outlining the possibilities of connecting them to public systems also.

General Characteristics

The tasks of developing domestic TELEDATA systems can be broken down into two parts:

--creating possibilities for a public TELEDATA service, and

--developing closed TELEDATA systems for service and managing units which have computers.

As a solution to these two partial tasks there might develop a uniform service system by means of which authorized users might access both the public TELEDATA services and the services of the closed TELEDATA systems with the aid of the gateway function through the public network.

In our country the Post Office plans to create a public TELEDATA center in the near future, or to operate one experimentally on the basis of acquisition of a switching center. Until the experiment ends and the experiences are evaluated, one can expect primarily the spread of closed systems. In the present article we describe basic developments taking place in the area of TELEDATA systems. We will turn in a later article to developmental work on applications systems and to ideas connected with creation of a public TELEDATA network.

Experiments and developments connected with closed TELEDATA systems are taking place in the SZKI [Computer Technology Coordination Institute]. The services of the Bildschirmtext in-house system can be accessed on the Siemens computer of the institute. The experiences of operating this and its user interface can serve as a model for designing closed systems and developing applications.

Development has begun also of a closed TELEDATA system built around an ESZ 1015 (the SZKITA system). We introduced a model of the system at the spring 1982 Budapest International Fair. The system shown contains user samples from the areas of commercial, agricultural and enterprise applications. We wanted to achieve a dual goal with the development of the ECZ 1015 based TELEDATA system:

--the hardware/software components of the system should be capable of being installed ready-to-go in the environment of any ESZR user with the proper remote data processing possibilities, and

--the system should be capable of being used as a service on the computers of the SZKI.

An independent result of the developments taking place at the SZKI is a closed TELEDATA system based on a professional personal computer which makes it possible for applications requiring small data files to establish a link with larger closed TELEDATA systems (for example, based on an ECZ 1015) in the case of larger files.

The general structure of the TELEDATA systems outlined above can be illustrated in a simplified form with Figure 1.

As opposed to traditional remote data processing applications the TELEDATA systems offer the end user:

--simpler operation;

--display modes expanded with color effects and graphic possibilities; and

--they are cheaper.

It is expected that these properties will make computer services possible in areas where it has not been possible to use the tools of modern information technology within earlier framework.

Typical applications areas of the TELEDATA systems described might be:

--inventory recordkeeping,

--inventory management,

--enterprise information systems,

--trade (department store chains, discount stores, purchasing on basis of samples, etc.),

--tourism,

--reservation systems (transportation, hotels),

--banking, etc.

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ELECTRONICS TECHNOLOGIES IN INFORMATION ELECTRONICS

Budapest FINOMMECHANIKA-MIKROTECHNIKA in Hungarian No 3, 1984 pp 90-92

[Article by Dr W. Kienast, university professor, Ilmenau Technical College, Ilmenau, GDR]

[Text] 1. Introduction

In the information technology branch instruction at the Technology Institute of the Ilmenau Technical College we attribute great significance to modern training satisfying high practical requirements. For this reason the questions of use of electronic technology and computer technology stand in the center of our interest. The study plan prescribed by the ministry (1) ensures that the several departments will also use in lectures and practical instruction the research results achieved in their areas.

It is a unique characteristic of the electronics technology taught in the Ilmenau Technology Institute that it also includes computer technology. Going beyond this we give lectures on printed circuit technology. Since in the future printed circuits will be the medium for electronic parts, our students must study the way in which they are produced in practice as well. We have also introduced the teaching of circuit computation in the circuit technology section. In the design and technology section we have developed design possibilities for the topology of circuits (placement and connection of parts). The digitization of design takes place with the aid of digitron and a K 1520 minicomputer; we draw connection diagrams with an Admap plotter; and we drill the circuits with an N/C drill. Finally, we seat the parts on a printed wiring card, solder them and test them; all these operations are done by hand.

Solving these tasks came up within the framework of complex practical instruction. We devote 12 hours to producing and testing a printed circuit. One of the essential points for carrying out the task is that the students should become acquainted with the digitizing unit, operation of the plotter, use of photolithographic procedures and seating and soldering the parts.

2. Lectures and Practical Instruction

A total of 330 hours are available for teaching electronics technology (2) divided up according to Table 1.

Table 1. Instruction Time Plan for Electronics Technology

Subjects	Semester and Number of Hours of Lecture/Practice				
	Fifth	Sixth	Seventh	Eighth	Ninth
1. Electronics technology	30/15	15/30	factory engineer practice		
2. Microelectronics	15/15				
3. Informational electronic equipment				--/30	
4. Microprocessor technology		15/15		15/15	--/30
5. CAD					
5.1 Printed circuits		--/15			
5.2 Thick film hybrid circuits				--/30	
5.3 Integrated circuits		30/15			
330 hours	45/30	50/75		15/75	--/30
	75 hours	135 hours		90 hours	30 hours

In the following we will describe the several subjects in more detail.

2.1 Electronics Technology (3,4,5,6)

The lecture material and practical instruction for this subject offer basic information for the solution of the following problems:

--scientific work methods, problems arising when creating algorithms,
--problems with heating of parts and devices
--designing printed circuits,
--mechanical vibrations appearing in electric devices,
--joining technologies,
--thin film technology,
--thick film technology, and
--printed circuit technology, including photolithographic procedures.

The students must report in three summary works written at home about the information obtained in practical instruction concerning printed circuits, thin film circuits and thick film circuits. The practical instruction deals primarily with calculations.

2.2 Microelectronics (7, 10)

In the lectures and practical hours for this subject the students get information about modern microelectronics. Within this we deal with the following:

--planar technology and the more important basic technologies,
--circuit design: logic; transformation of circuits so that they can be made as integrated circuits,
--layout: manual and computer aided circuit design, pattern generator, mask preparation,

--structural construction,
--assembly,
--measurement techniques, testing,
--X-ray lithography, ion implantation, plasma etching, and
--developmental trends

In the course of practical instruction the students also design custom-made circuits.

2.3 Informational Electronic Equipment

In this subject we test and evaluate, from the viewpoint of their function and the technology used, equipment manufactured in industry on the basis of a few tasks. The students report on the results of these tests in a 10 minute talk, the purpose of which is to master the technique of scientific discourse. The talk must be prepared in writing also, to a maximum of five pages. We deal with the following equipment among others: telephone, tape recorder, small computers, carrier frequency transmission equipment, radio receivers, pocket calculators, impulse generator, etc.

The circuits, technologies used, design, possibilities of using microelectronics and developmental proposals and plans constitute the subject of the evaluation.

2.4 Microprocessor Technology (8,9)

In the lectures the students learn the basics not only of the hardware but also to a certain extent of the software.

Hardware:

--U 808, U880, Z80 microprocessors
--RAM, ROM, EPROM, CPU, PIO, CTC,
--interface,
--K 1520 microcomputer, and
--the "Microcombi" developed by the Ilmenau Technology Institute.

Software:

--basics of programming the K 1520 microcomputer,
--loading the machine program,
--data input and retrieval (memories),
--addressing the memory partitions in operation,
--checking the CPU registers, and
--correcting the time of program running.

In connection with this we organize exercises on the following themes:

--data storage and data presentation, program initiation, input/output,
--preparing simple programs,
--preparing a program for shift register simulation,
--simulation of a flip-flop circuit.

And for the talented students:

--CTC programming, and
--compiling a program and transferring it to a KRS 4201 minicomputer with a KRAS-K 1520 cross-assembler.

2.5 CAD

We plan about 20 hours for lectures and practical exercises on this subject.

2.5.1 CAD, Printed Circuits

We demonstrate a program developed exclusively for instructional purposes which was prepared for the EC 1040 large computer on the basis of a devised algorithm. The basic idea is the following: After designing the position of one unit, for example a terminal, we position an element so that its connecting distance to the unit placed first is as short as possible. The position of every newly placed element must be checked for all four possible movements (degrees of freedom). But before we put it in its final position we must check to see that neighboring elements do not cover one another. In further programming every unit given a final position in this manner is regarded as a previously positioned unit. The layout of the units is completed when every element is in position or when the surface of the printed circuit is covered. One can also position mixed parts with the aid of the algorithm.

When using this program we must satisfy the following requirements and conditions:

--the parts are represented by their square basic surface,
--the dimensions of the printed circuit must be given,
--the parts can be positioned only parallel with the edges of the printed circuit,
--at least one element must be pre-positioned,
--protected areas are possible,
--the number of parts must be fewer than 100,
--the number of connecting pins must be fewer than 100, and
--the length of the printed circuit must be less than 250 mm and its width must be less than 230 mm.

Data processing and use of the program are the task of the students, in the course of which they master operation of the large computer. Finally they prepare a report about the results achieved with manual or EC 1040 large computer printing according to a ray type algorithm.

2.5.2 CAD, Thick Film Hybrid Circuits

We describe various program versions and the special requirements of thick film technology. We describe in detail a program prepared for computer aided design and provide the circuits for its practical realization.

The work done with a computer provided with a graphic display includes the following:

--the students learn how to operate the computer,
--circuit layout design,
--demonstrating a few routines for automatic design, and
--evaluating the results.

2.5.3 Computer Aided Circuit Design

We demonstrate the planning of the geometric layout of semiconductor circuits, for example an inverter stage, taking into consideration the technological possibilities and the electric parameters.

The seminars held in this subject help the students to practice the computer aided design of circuits with the aid of a graphic display.

3. Summary

One can see from the study what the more important points of electronic technology and the application of computer technology are which we emphasize in the course of instruction when training engineers dealing with information electronics at the Ilmenau Technology Institute. We attritube great significance to the teaching of computer aided circuit design (CAD), including the use of micro, mini and large computers and special computers with graphic displays.

As a result of our instructional activity the engineers leaving our institute will be good experts in both circuit design and computer technology and will take their place accordingly in the areas of CAD and CAM.

FOOTNOTES

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SENSOR DEVELOPMENT VIEWED

Budapest MERES ES AUTOMATIKA in Hungarian No 4, 1984 pp 125-127

[Article by Dr Tamas Kemeny, MIKA [Instrument Industry Research Institute], Measurement Technology Developmental Enterprise, Budapest; received for publication 26 Jan 84]

[Excerpt] By way of introduction the article calls attention to the ever increasing importance of sensors. The rate of sensor development and manufacture has lagged behind that of electronic signal processing systems. The article analyses the development of needs, gives a percentage breakdown of sensors according to parameters, and finally turns to the expected trends.

In 1982, on a commission from the Ministry of Industry, the Instrument Industry Research Institute prepared an analytical study for the council of the T24 ministerial program. This summarized what technical solutions were known for measuring the several parameters, which of these should be regarded as having prospects, and which of the latter we recommend for development with concentrated effort. The problem area is more timely than ever before. By bringing in the appropriate special departments of the Measurement Technology and Automation Science Association, every possible social background is given for initiation of a domestic sensor program.

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SEMICONDUCTOR OPTOELECTRONIC SENSORS

Budapest MERES ES AUTOMATIKA in Hungarian No 4, 1984, pp 127-131

[Article by Dr Gyula Pasztor, Microelectronics Enterprise, Budapest and Dr Gyorgy Erlaky and Dr Emil Hahn, Electronics Faculty, Budapest Technical University; received for publication 15 Nov 83]

[Authors' Summary] Optoelectronic semiconductors are elements of modern electronics being used in an ever broader sphere. We find them in general use and in industrial automatic devices such as in automatic cash registers, where the price of the item purchase is determined by optical reading of the article code, in industrial robots, where they are used to measure or sense displacement and swing, in the electronic speedometers of automobiles and in a number of optical fiber data transmission and communications devices, to mention only a few selected examples.

In this article we have limited ourselves to the basic elements. Thus a number of optoelectronic fields are omitted from the discussion, such as optoelectronic integrated circuits and sensors and circuits for image transformation and form recognition.

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PIEZO-RESISTIVE SILICON PRESSURE SENSORS

Budapest MERES ES AUTOMATIKA in Hungarian No 4, 1984 pp 132-136

[Article by Istvan Almasi, Istvan Barsony and Janos Berkecz, Microelectronics Enterprise, Budapest]

[Authors' Summary] The article discusses the developmental aspects of one of the most important types of microelectronic sensors, silicon pressure sensors operating on the principle of piezo-resistivity.

The basic requirements made of pressure sensors are high pressure sensitivity, small nonlinearity and low temperature dependence. Taking these into consideration, the authors describe the technical-theoretical background on the basis of which the Microelectronics Enterprise developed a family of suitable quality pressure sensors to measure a pressure range between 0.4 and 600 bar.

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PHOTOCONDUCTIVE FIBER SENSORS

Budapest MERES ES AUTOMATIKA in Hungarian No 4, 1984 pp 137-141

[Article by Dr Janos Szabo, Technical Physics Research Institute of the Hungarian Academy of Sciences, Budapest; received for publication 13 Jul 83]

[Authors' Summary] On the basis of a review of the literature the article provides an outline review of the most important groups of photoconductive fiber sensors, their principles of operation and a few applications areas. Because of the limited space for the summary the author could not try to be complete; he wanted to call the attention of readers to the possibilities of their many-sided use by describing some of the more interesting results in this area which is developing extraordinarily dynamically.

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8984
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GAS SENSORS WITH THICK FILM TECHNOLOGY

Budapest MERES ES AUTOMATIKA in Hungarian No 4, 1984 pp 143-146

[Article by Janos Mizsei, Electronics Devices Faculty, Budapest Technical University, and Mrs Pal Kolonits, Microelectronics Enterprise, Budapest; received for publication 23 Sept 83]

[Excerpts] One of the significant groups of thick film sensors which can be manufactured with very productive methods in many versions is that of gas sensors. Their operation is based on the effect on the resistance of the oxide of the electron transition which develops between an oxide with semiconductor properties and the gas being absorbed.

The thick film humidity sensors contain a porous dielectric. The capacitance or alternating current resistance of the condensers which develop in them show an easily measured change as a function of the relative moisture content. The sensor versions developed at the MEV [Microelectronics Enterprise] show suitable sensitivity and speed.

The OMFB [National Technical Development Committee] prepared a study regarding the user needs being manifested for sensors. In the course of this it turned out that the need was gigantic primarily in the following areas: for the chemical industry and foodstuffs industry a need for sensors or instruments to measure heat, moiture and gas concentration, and for the other branches of industry a need for sensors or instruments to measure pressure and deformation. Joining various central programs, research and development work in the area of thick film sensors began at the MEV in 1982. The intellectual and material preparedness of the MEV (experience with thick film technology and a supply of suitable tools) made it possible to prepare sensors (gas and moisture sensors) which showed the effect well in a very short time. In figure 3 one can see the R_g/R_o characteristic curves of a tin dioxide based sensor prepared at the MEV. Figure 4 shows the construction of the sensor. A characteristic curve of a moisture sensor can be seen in figure 5. It is useful to adapt the method of electric signal processing to the sensor. The hybrid integrated circuit technology offers the possibility for the electronics to correct characteristics of a not entirely regular logarithmic or linear sensor, thus ensuring the greatest possible precision. Thus, in accordance with the general custom, the domestic gas sensors will be available to domestic users together with the electronics.

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PRODUCTION AND USE OF FLEXIBLE PRINTED CIRCUITS

Budapest FINOMMECHANIKA-MIKROTECHNIKA in Hungarian No 5, May 84
pp 142-144

[Article by G. H. Beyer, production director, Hartmann & Braun AG, Helligenhaus, FRG]

[Excerpt] (Summary) The need for flexible printed wiring and rigid-flexible multilayer circuits is increasing in a number of areas and in the consumer industry. Problems may arise in the course of manufacture of flexible printed wiring. The article deals in detail with the adhesion of copper coating to polyimide material, especially with problems arising in connection with drilling. It describes the chromic acid and plasma etching process preceding through-hold electroplating, and the advantages and disadvantages of this.

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MOTIVE FOR DEVELOPMENT OF MULTILAYER PCB'S

Budapest FINOMMECHANIKA-MIKROTECHNIKA in Hungarian No 5, May 84
pp 149-152

[Article by E. D. Rode, Fa. E. D. Rode KG, Reinbek, FRG]

[Excerpt] (Summary) The article analyses the reasons for the development and use of multilayer printed wiring cards, which were raised by requirements of a physical character made of wiring by the swift development of integrated circuits.

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AUTOMATIC VISUAL INSPECTION OF IC PHOTOMASKS

Budapest HIRADASTECHNIKA in Hungarian No 5, 1984 pp 202-206

[Article by Zoltan Fazekas, of the Central Physics Research Institute of the Hungarian Academy of Sciences]

[Excerpts] Summary

The article discusses briefly general questions of industrial application of automatic visual inspection. It describes the economic and technical background of the automatic visual inspection of photomasks used in the manufacture of integrated circuits and various methods of inspection. It describes a characteristic system.

Concluding Thoughts and Plans

A fast image processing system has been developed at the KFKI [Central Physics Research Institute] (8). Based on this we want to create a photomask inspection system meeting the parameters of domestic manufacture of integrated circuits.

The inspection methods already described can be used separately or in combination with one another. It would be useful to be able to tell the system which inspection methods to use. Documenting the inspection decisions and locations of faults is an important task.

Mask inspection systems are being manufactured for commercial trade, for example by the American firm KLA. One can learn from their product specifications what technical parameters a mechanical "quality control inspector" of photomasks must have if it is to be called modern.

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REPRODUCTION OF HIGHLY DYNAMIC PICTURES WITH MICROPROCESSOR

Budapest MERES ES AUTOMATIKA in Hungarian No 6, 1984 pp 216-221

[Article by Dr Karoly Toth, of the Instrument and Measurement Technology Faculty of the Budapest Technical University, formerly of the Medicor Works: "Presentation of Highly Dynamic Images with Microprocessor Devices The Mediagnostic Medical Image Display"; received for publication 15 Dec 83]

[Excerpts] Structure of the Mediagnostic System

Before describing the system technology of the device we should briefly review the basic possibilities for realizing a gray scale transformation. The Medicor CT 0100/0150 and similar earlier devices operated as follows. On the basis of the image information stored in the operational memory of the central computer the CT loaded the gradation image to be computed into the refresh memory of the display generator for every middle value or setting of window width. The speed of the medium category computer needed for CT image reconstruction ensured as acceptable image manipulation time. The secondary evaluations being displayed later in time meant doubling the image processing system of the CT equipment, thus in the beginning its operation coincided with what was discussed earlier. The PDP 11/34 is a typical example of the computer being used today in the secondary evaluations. Just as an illustration, even Siemens, which is significant as a computer manufacturer, built its secondary evalutor on the American computer mentioned (5). It can be seen from what has been said that the above solution would lead to unacceptably great image manipulation times with a microcomputer based on an 8 bit, fixed instruction set microprocessor.

The swift development of semiconductor technology today, the significant increase in the capacity of semiconductor memories and the drastic reduction in their price offer an economical possibility for realization of a real-time gray scale transformation which differs from the earlier ones.

Instead of the customary bit size corresponding to a maximum gradation number, the refreshor memory of the display generator has been extended so much that the original image information can fit in it in its entire resolution. By using fast memories we carry out the transformation at the rate of refresh, in a real-time mode. When setting parameters we need to

reprogram only the memories containing the gradation function, and this can be done even with an ordinary microprocessor. The Mediagnostic works this way too. The system technology structure of a typical configuration can be seen in Figure 2. The rectangles with heavier right and lower sides indicate the MMT [Instrument and Measurement Technology Faculty] elements while those with heavier left and upper sides indicate the special Mediagnostic elements.

The device consists of two microprocessor units in a master-slave link. The master is a general purpose microcomputer--made of standard MMT elements--in the operating system of which the system programs or the image processing program of the Mediagnostic can be run depending on the structure. Standard interface and special cards can be built, according to the given user needs, into the microcomputer, which is based on a Z80 microprocessor and which contains, in its basic structure, interrupt logic, DMA and floppy controller, console interface and a memory of optional ROM-RAM composition.

In the case of the Mediagnostic, standard elements create a real-time clock, a parallel interface connecting to a computer for the Medicor 0100/0150 or Medect-18 tomographs and an analog input unit connecting the analog graphic positioning devices. Through the computer interface--in addition to transmitting images--it is possible to emulate terminal input in the first case, or have full terminal emulation in the second case, and carry out control console tasks. The special Mediagnostic elements are: an interface realizing the master-slave link, which serves to transmit commands to the display generator or receive the connection data, and 2 data channel providing special transmission of image information. The latter is needed for reasons of speed. In the interest of better utilization of the disks the CT pictures are stored in the byte organized floppy background store in packed form; two 12 bit CT pixels make up 3 bytes. The image information data channel contains an HW compressor or decompressor unit; that is, the 3 bytes written in from the master side can be read immediately as two words on the slave side and vice versa.

The slave system is made up of graphic display generator which can be programmed by the user, standard MMT elements and special Mediagnostic elements. Among the latter the video bus, together with the MMT bus, ensures swift connection. In the interest of accelerating operational speed an arithmetic processor unit based on an AM9511 is used with the Z80 microprocessor and both processors are of the 4 MH_z type. In addition to the standard MMT memories and the already mentioned master-slave links the display generator contains four types of special Mediagnostic elements.

The synchronous generator produces the signals needed to generate the 625 line video signal, composed according to the OIRT norm, and to address the large memories. The synchronous net built around the 16 MH_z quartz oscillator is microprogrammed and thus the TV norm produced and the image adjusted to it can be set optimally.

The refresh memory is suitable for accepting a maximum of 18 bit information and has 400x300 fixed geometric resolution--microprogrammed in

the synchronous unit. The 400 pixels per line means that the data vary at a rate of 8 MH_z at the output of the cards from the direction of the video bus. The 18 bits of information are divided into two parts--12 bits of image information (CT number) and 6 bits of specially treated overlay data bits. By virtue of the latter one can place alphanumeric, graphic, statistical, etc. information on the image in such a way that the original image to be displayed is not changed in memory is of the dual port type and the operation of the two sides--MMT or video--is largely independent.

In the first half of the cycle--the video phase--the memory control, which works with a basic cycle of 1 microsecond, simultaneously reads the 8 pixel data and sends them to temporary registers from which they go to the video bus at the refresh rate. In the second half of the cycle--MMT phase--data transmission can be initiated from the MMT side. Writing into the refresh memory is buffered while reading is synchronized (the processor must wait for the MMT phase). The maximum 1 MH_z MMT side data transmission can be only approximated with the 4 MH_z Z80 microprocessor. The 128 K x 18 bit entire refresh memory can be programmed with sequential addressing in three modes via a 16 K byte window. Appropriate segment selection and setting the operating modes takes place through peripheral registers. The constant video side reading provides the refresh of the MK 4116 type 16 K x 1 bit organization dynamic memories used.

The gray scale transformation unit realizes the transformation from 12 bits to 6 bits at the rate of the pixel frequency (8 MH_z). An optional gradation function can be produced with suitable programming, taking into consideration the maximal 64 gradation resolution. In the interest of facilitating evaluation it is the custom to draw gradation scales along with the pictures displayed. The transformation unit contains two programmable memory blocks with the aid of which one can present two horizontal or vertical gradation scales on the picture. Display of the original picture ends in the points of the scale.

The video unit produces the 6 bit digital light intensity signal on the basis of the gray level data and overlay information; this becomes a black and white video signal after D/A conversion and mixing with the synchronous signals. The use of pseudo color is very widespread in image processing systems because the human eye's sensitivity to colors is greater and the fatigue is less than in a monochromatic case. The color memories providing the pseudo color are addressed by the gray level or overlay data and D/A converters connected to their outputs produce RGB separated color light intensity signals. The color memories make possible the use of sixteen color scales with 64 steps.

The structure of the slave system is such that by doubling the special Mediagnostic display elements one can create two entirely independent image channels.

Summary

In the article we have described the structure and operation of the Mediagnostic medical image processing system. The device, suitable for displaying highly dynamic pictures, was developed primarily to evaluate CT images. The microprocessor structure of the device is a good example of how, using a unique structure suitable for the task, one can solve even in a microprocessor environment tasks which generally require a computer.

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